The genus Cortinarius: a preliminary study

CALVIN HENRY KAUFFMAN

INTRODUCTION

The genus *Cortinarius*, the largest genus of the *Agaricaceae*, is of special interest because of the small amount of work done on it, especially in this country. Fries in Europe and Peck in America have described nearly all the species so far reported. In recent years, Britzelmayr * has published a number of descriptions of plants found in Bavaria, Germany, where the genus seems to be well represented. That few students study the genus seriously is perhaps due to the fact that it presents certain peculiar difficulties. These, although great enough, are not more than those found in some other parts of the mycological field. Saccardo seems to think that the changing colors deter mycologists from paying more attention to the group. The fading of the colors almost immediately after maturity is certainly a troublesome factor for the beginner, and makes it less easy for him to progress rapidly in their study. For these reasons it is necessary, first of all, to make a thorough acquaintance with the various forms as they occur in their native haunts. By repeatedly collecting the same species in the same localities as well as elsewhere, one should be able at last to distinguish even closely related forms. In this way, the writer has succeeded, as he hopes, in making some small progress towards a better knowledge of the genus.

Three successive summers were spent in collecting material, special attention being paid to the habitat and variabilities of the different species. The same places were visited year after year, and in this way duplicates of the same species from the same spot were frequently obtained. The work was done at Cornell University, Ithaca, N. Y., and the rich collecting grounds in its vicinity afforded abundant material. The fine collection of colored plates of European species found in the botanical laboratory made pos-

* Hymenomyceten aus Südbayern.

sible what progress there was. To Professor G. F. Atkinson, whose enthusiasm in this phase of botany is well known, I owe the inspiration to take up and continue the study.

HISTORICAL

Like many of the generic names of the fleshy fungi, that of *Cortinarius* was bestowed upon it in the time of Persoon and Fries. In the *Synopsis Methodica Fungorum* (1801), Persoon placed "*cortinarius*" as a section under the genus *Agaricus*. Here he included 52 species. Fries, somewhat later (1836–38),* raised the group to generic rank. Saccardo gives him credit for 209 species, including some originally described by Persoon under *Agaricus*. Britzelmayr has described 64. These two men have done most of the work in continental Europe. In North America Professor Peck has described 70 species, nearly all of which belong to the State of New York. The descriptions of these are mostly published in the reports of the regents of the State of New York, beginning with the twenty-third report.

GENERAL CONSIDERATIONS

The genus *Cortinarius* is easily recognized in the field after a season's practice in collecting. The genera most closely allied to it are *Inocybe* and *Hebeloma*, and cases occur where it is at first impossible to decide where the plant in question belongs; but these instances are rather few. *Hebeloma* and *Inocybe*, like *Cortinarius*, grow on the ground. The former is usually separated by the absence of a veil when young, and the gills are paler when mature. *Inocybe* also has paler gills and spores when mature, and is, as a rule, smaller; many of its species are further characterized by cystidia on the gills. Stevenson† says "*Cortinarius* is readily distinguished by its peculiar habit, but is badly defined by artificial characters." This statement is certainly borne out by my experience. It will nevertheless be well at this point to give a brief diagnosis of the genus.

GENERIC DESCRIPTION

Fruit-body fleshy, putrescent, with a veil, this composed of silky threads which in the young plant connect the edge of the

* Epicrisis 255.

† British Fungi.

pileus with the stem. Gills persistent, dry, changing color during the process of maturing, at length powdery with the clinging spores. Trama of pileus and stem fibrillose. Spores, when mature, for the most part cinnamon-brown in mass, subochraceus to rusty-brown by transmitted light. (A more detailed description of the veil must be looked for below.)

The genus was divided by Fries into six *subgenera*. There is hardly a doubt that these will be erected, either wholly or in part, into full genera. Some writers have already done so, but until we know more of the developmental history of the various forms included in these subgenera, it seems to me a rash procedure to multiply genera. The following key, together with a diagnosis of the subgenera, is herewith presented:

Key to Subgenera

A.	Pileus, or both pileus and stem, viscid.	*B.*
	Neither pileus nor stem viscid.	*C.*
B.	Both pileus and stem viscid or glutinous from the universal veil.	*Myxacium.*
	Surface of pileus alone viscid or glutinous.	*Phlegmacium.*
C.	Plant when young covered by a universal veil.	*Telamonia.*
	Plant without a universal veil.	*D.*
D.	Pileus hygrophanous, glabrous; color fading on drying.	*Hydrocybe.*
	Pileus dry, not hygrophanous.	*E.*
E.	Plants large to medium; stem stout, clavate.	*Inoloma.*
	Plants small to medium; stem slender, equal, pileus subsilky.	*Dermocybe.*

MYXACIUM. Pileus fleshy, rather thin. Entire young plant covered by a universal veil which is glutinous and the shreds of which cling to the stem, making it viscous also; on drying, pileus and stem become polished.

PHLEGMACIUM. Pileus fleshy throughout, with a thin gelatinous cuticle which becomes viscid. Stem and cortina dry. No universal veil. Stout plants.

TELAMONIA. Flesh of pileus thin, or somewhat thicker on disk, scissile; pileus hygrophanous, at length covered by white, superficial fibrils, the remains of the universal veil. Entire plant when young covered by the universal veil, which remains on the stem either as partial rings or as a sheath. Partial veil soon disappearing.

HYDROCYBE. No universal veil. Pileus hygrophanous, changing color on drying. Flesh thin, scissile. The partial veil sometimes remaining as an evanescent annulus on the stem.

INOLOMA. Pileus fleshy, rather thick throughout, dry; the scales or fibrils on the surface are not due to a universal veil, but

FIGURE 1. *Cortinarius sterilis* Kauff. Slightly reduced. Spores drawn

FIGURE 1. *Cortinarius sterilis* Kauff. Slightly reduced. Spores drawn

are loosened from the tramal tissue beneath; not hygrophanous. Stem stout and fleshy, the base enlarged and tapering upward, *i. e.*, clavate. No universal veil.

DERMOCYBE. Pileus somewhat innately silky like the preceding, but soon glabrous, dry and not hygrophanous. Flesh thin. Stem slender, rather rigid on exterior, equal or attenuated, stuffed or hollow. No universal veil. Partial veil fibrillose. Plants usually bright-colored.

STRUCTURE OF PILEUS AND STEM

There is nothing peculiar in the trama of the pileus of this genus, by which it may be distinguished from related genera. When young, the general description given by de Bary* for *Mycena*, etc., applies to everything but the veils. The hyphæ of the basal part of the young "button" are composed of rather large, oblong cells with air spaces between, these cells becoming smaller and more compact as they approach the apex of the "button," and finally end in the beginnings of the young hymenium as a dense, close-lying mass of deeply staining, minute hyphæ. At least, this is true of *C. squamulosus* Pk. and such others as have been examined. In the mature plant, the trama is largely made up of hyphæ, loosely interwoven, and containing cells, similar to those found in the basal part of the young plant; these hyphæ usually become narrower and longer in the gills, gradually changing to the still narrower subhymenial cells in the manner of many other agarics.

There is one point of interest and importance, however, which has some bearing on taxonomy. This is the cuticle or surface layer of the pileus. In the subgenus *Phlegmacium*, the cells of this layer are long and narrow, lying horizontally parallel or interwoven on the top of the trama; their walls are easily transformed, when sufficient moisture is present, into a gelatinous substance. When a vertical section is made through the surface of the pileus, and this is mounted in water, this layer widens considerably, or it may be pulled out by the razor so as to assume a more or less vertical position. Beneath this layer may be seen a transition group of cells which connect with the ordinary tramal tissue below.

In the subgenera with a dry pileus and no universal veil, the upper layer is composed of narrow, more or less long innate hyphæ, which compose the silky fibrils there met with.

* Fungi, Mycetozoa, and Bacteria 55. 1887.

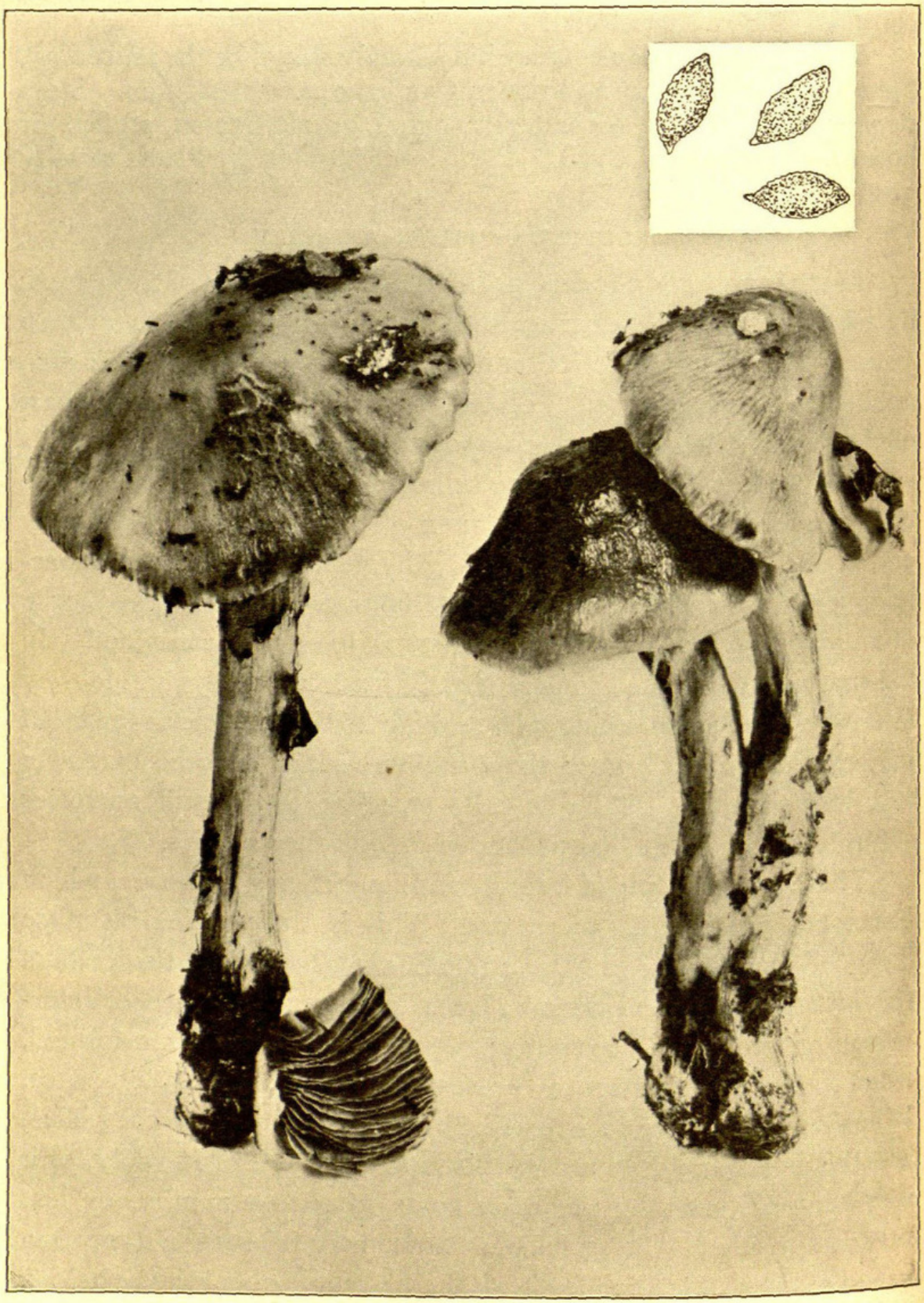

FIGURE 2. *Cortinarius cylindripes* Kauff.. Reduced one-eleventh. Spores as in Fig. 1.

The tissue of the stem, as one would expect from the conditions of the young "button," is very loosely put together in the mature plant. Further study is needed to determine the exact character in certain of the subgenera. No gelatinous layer is ever present so far as known, its gelatinous character in the subgenus *Myxacium* being due to the remains of the universal veil. The tissue of the stipe is continuous with that of the pileus. The term "fibrillose" is, it seems, the accepted word to described the tramal tissue found in this genus.

CORTINA AND UNIVERSAL VEIL

The genus *Cortinarius* is said to be especially characterized by the silky veil referred to in the diagnosis of the genus. This veil has usually been called "cobwebby" or "arachnoid," because of its peculiar texture. In some of the subgenera, however, there occurs a structure which is not included in the above definition. If for example we take a highly differentiated species, such as *Cortinarius armillatus* Fr., we can observe at the proper stage what might be considered as two veils; the "cobwebby" or inner veil, also called the *cortina*, and an adjacent tissue, the *universal veil*.

The *cortina* is the tissue, composed of loose hyphae, which forms a "cobwebby" curtain in front of, *i. e.*, below the lamellae. The threads of this curtain or *cortina* seem to be inserted for some distance vertically along the stem, and converge in a wedge-shaped manner as they meet the edge of the pileus. In *C. squamulosus* Pk., it clearly coalesces with the trama of the margin of the pileus, and is therefore not superficial in that species. In the young stages of this plant — *e. g.*, when it is only 3 mm. thick — its texture is the same as later, and it seems to fill the cavity under the primordium of the lamellae. Whether this is the typical insertion of a "partial veil" into the pileus must be left an open question till I am able to examine young stages of more species. As the pileus expands and the hymenium matures, the *cortina* gradually disappears. In many cases its remains can be detected at its insertion on the stem, by the fact that the falling spores are caught in its loose meshes and remain as a cinnamon, annular stain on the upper part of the stem. In other cases the margin

of the pileus as it spreads, carries with it the shreds of the torn veil in the form of a narrow, silky decoration.

Lying adjacent to the *cortina*, and perhaps continuous with it, on its outer side, is a layer of tissue which envelops the whole plant when young, or at least the part below the margin of the pileus. This is called the *universal veil*. It is apparently not present in all the subgenera of the genus, but when present, as in *C. armillatus* Fr., it is in most cases easily recognized. The universal veil is of somewhat different texture and composition in the different species. In the subgenus *Myxacium* it is glutinous, and gives the glutinous character to the plant. In some of the species of the subgenus *Telamonia*, the hyphae which compose it are so interwoven as to make it extremely tenacious and lasting in character. Where this is the case, it is quite persistent during the later development of the plant, and is represented on the stem as a series of more or less regular bands which encircle it; or, the developing pileus breaks away in such a manner as to leave the part on the stem intact, with a resultant sheath or "stocking" clothing the stem below, in which case the stem is said to be peronate. In others — and this is usually the case in smaller species — the universal veil is quite thin and therefore more evanescent in character. The result is that the remnants of the torn veil soon disappear, or leave such a slight annulus that it is sometimes difficult to determine its existence. The resultant annulus usually occupies a medium or low position on the stem.

It is not quite clear what Fries means when in his generic description he says, "Veil arachnoid, distinct from the cuticle of the pileus, superficial."* He certainly could not have meant the universal veil in the sense in which I have used the term. Then the only interpretation possible, it seems, is to assume that he meant the cortina, which is present in all the subgenera, and that it was considered by him to be continued around the edge and over the surface of the pileus, and, if so, identical to that extent with the universal veil.

It seems that Winter † saw the ambiguity in Fries' description, for he says, "Plant fleshy, putrescent, with a cobwebby veil," with

* Epicrisis 255. 1836.

† Rabenhorst, Kryptogamen Flora, 1: 576. 1883 [2d ed.].

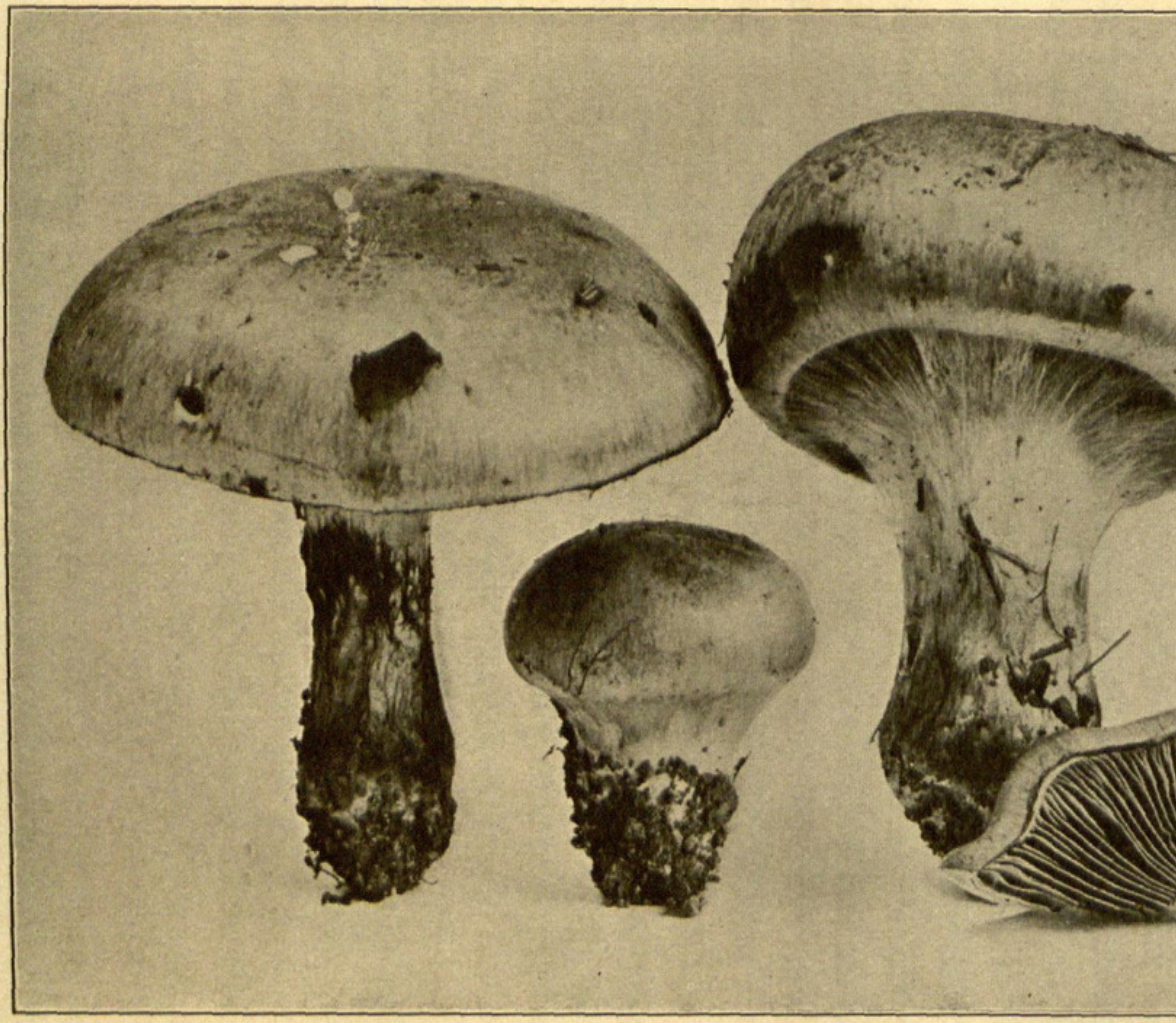

FIGURE 3. *Cortinarius olivaceo-stramineus* Kauft. Natural

no mention of its connection with the pileus or of its being superficial to anything. Then in a note he adds, "*Cortinarius* is especially characterized by its velum, which consists of cobwebby threads (hyphæ), and is of a different texture from the cuticle of the pileus. This veil remains after it is finally torn, sometimes on the edge of the pileus, sometimes on the stem, etc. It is here called the cortina." It will probably be found that this cortina is not always continued over the pileus, and hence is not always superficial. The texture of the cortina and that of the surface of the pileus are certainly different in some cases. Whether the cortina is continuous in some cases with a superficial layer of the pileus; whether there is really a superficial cuticle in all the subgenera; or in what cases the cuticle, when present, is continuous with the outer layer of the veil, *i. e.*, the universal veil, must be left until more species can be studied in the young stage.

The writer believes it will aid in clearness of diagnosis of species to use the term "universal veil" for the outer layer of Fries' velum, since this tissue is differentiated to such an extent as to be easily distinguished from the cortina.

As already seen, the universal veil belongs to the subgenera *Myxacium* and *Telamonia*. As to the chances of a universal veil in the subgenus *Phlegmacium*, it may be worth while to call attention to a note by Stevenson,* under *C. turmalis*, in which he considers the scaly covering of a number of plants of the *Phlegmacium* group as the remains of the universal veil. In the subgenus *Telamonia* an important character, besides the universal veil, is said to be the hygrophanous pileus. This has made it rather difficult to place some of our American species which have a dry pileus, but which have a universal veil. Peck placed *C. flavifolius* in *Telamonia* in spite of its dry pileus. It is likely that *C. annulatus* Pk. will be found to belong there when its veil has been thoroughly investigated. A study of *C. squamulosus*, in the very young stage, showed a beautifully differentiated layer of tissue surrounding the young "button," which looks very much like a universal veil. It seems desirable to neglect the hygrophanous character in this subgenus so as to admit the above and similar species. If this is said to conflict with the natural character of the subgenus, it is

* British Fungi 2: 4.

equally true that placing it among the *Inolomata* defies the natural limits of that subgenus. No other course would then be left but to erect another subgenus, and this is not desirable. Professor Earle, it seems to me, takes the correct view when he separates *Telamonia* from the others on the basis of a universal veil.

GILLS

The *structure* and the *texture* of the gills afford no special help to the student. Britzelmayr,* it is true, considered the method of attachment of the gills to the stem as one of the most valuable characters of the genus, but this does not seem to the writer to be so important. Gillet, in his key, makes considerable use of the serration of the gills; it may be that this can be used to some extent, but it is certainly a very uncertain characteristic.

One of the most helpful characteristics, on the other hand, is *the color of the young gills.* This may be white, olivaceous, violet, blue, red or yellow in the different species, and this character was made use of by Fries to separate the subgenera into further divisions. After the gills attain maturity, these colors are all transformed into some shade of cinnamon. The final appearance of the gills is due to an intermixture of the original color of the gills, and that of the cinnamon-brown spores; this makes it possible at times, even in old specimens, to determine what was the color of the gills in the young plant.

SPORES

The *color* of the young spores is more or less hyaline, or they may be tinged with the same color as the gills. After maturity, the mass always reflects predominantly the cinnamon-brown by which we characterize the genus. Occasionally an ochraceous or yellow tinge prevails, but one can hardly agree with Fries that they are always "subochraceus supra chartam albam." The slight variation in color can hardly be used as a specific character, and Professor Peck no doubt was well aware of this when he refrained from using it in a single description.

The *shape* of the spores is more useful. They may vary all the way from a fairly spherical spore to one whose length is three

* Botanisches Centralblatt 51: 2.

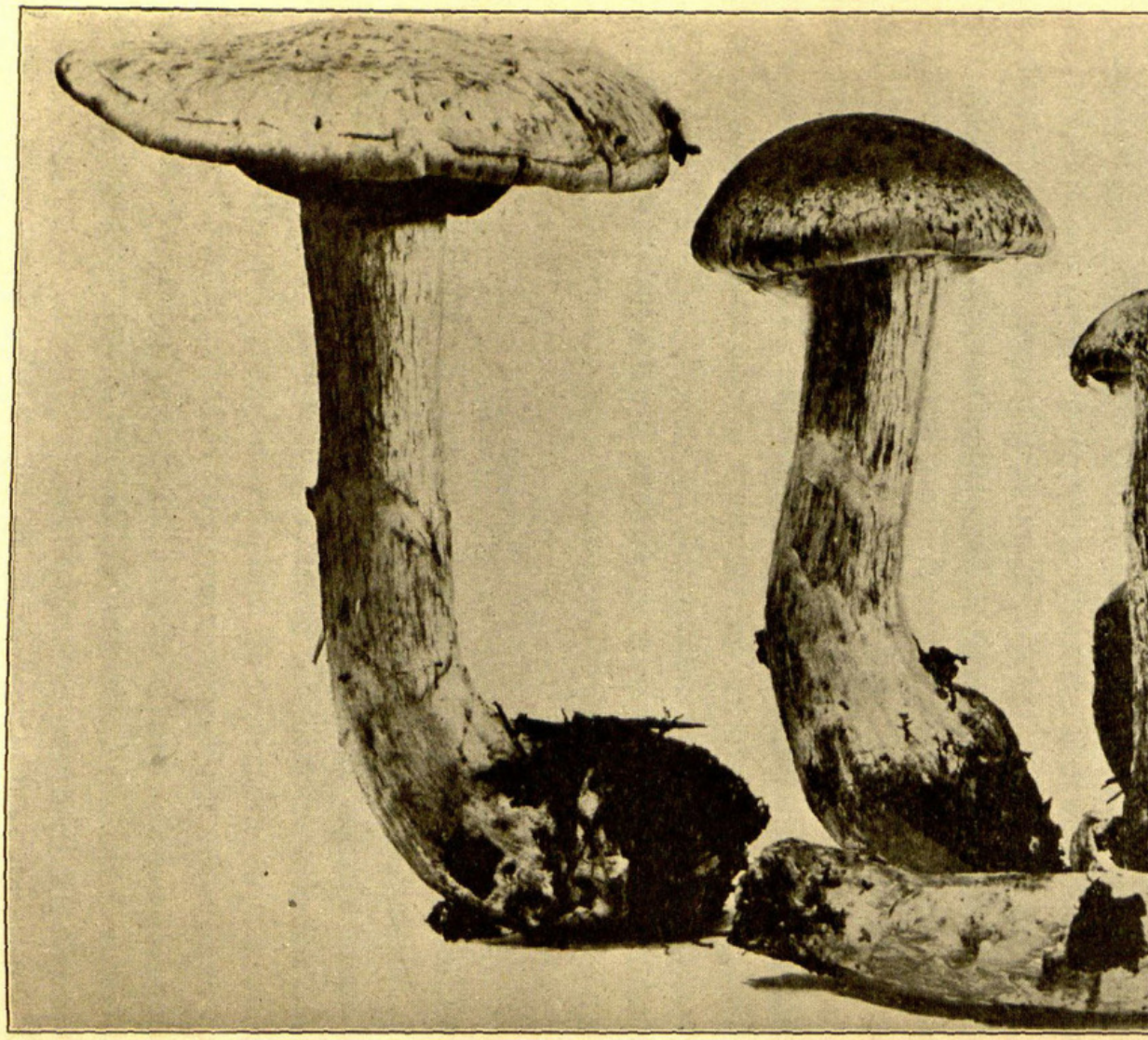

FIGURE 4. *Cortinarius umidicola* Kauff. About five-sevenths natural si

times its width. An apiculus, or projection, is usually noticeable and represents the point where the spore is attached to the sterigma.

The spores also vary in the *structure* of the epispore. This is often covered with spiny or tubercular processes; in other cases the spores are quite smooth. In using this as a specific character one must never lose sight of the fact that when young all spores are smooth. It is therefore necessary to make sure that the spores referred to are mature.

The *size* of the spores is, in my opinion, of much greater value for diagnostic purposes, than has hitherto been recognized. There is no doubt that the size of the spores of a single individual varies, and that it varies when there is every evidence that the spores are mature. But that they vary within limits, which are sufficiently constant, any one can determine for himself. One need only take measurements of a great many spores from a number of individuals of an easily recognized species (it is hoped that there are a few such species). One finds, indeed, a certain number of abnormal spores which are larger or smaller than the majority. But these should not be taken into account. It is time that we look more closely into the microscopical characters of these plants, and it is a pleasure to read Mr. Massee's discussion of this point in his recent monograph of the genus *Inocybe*.*

The spores of the genus *Cortinarius* have in all cases examined been found constant within limits. These limits are at times remarkably narrow, at other times just as remarkably wide. For example, a plant which has usually been called *C. alboviolaceus* Fr. in this country, has spores, which at maturity, are from 6.5 to 9.5 μ long, — it is meant by this that the average spores found in the field of the microscope in several mounts, and of as near the mature color as possible, are within these limits. A few may be longer, a number of younger, paler ones are shorter, but spores from this same species always show this same variability. On the other hand, *C. annulatus* Pk. has rather constant spores, somewhat spheroid, 7 μ long by 6.5 μ broad. In this case a single figure is sufficient to denote the length or breadth.

Several species have been studied in prepared sections, in which

* Ann. Bot. 18: 459.

FIGURE 5. *Cortinarius croceocolor* Kauft. Natural size. Spo

binucleate spores are evidently the rule. This, however, is not the place to discuss the matter further.

Of how much value the basidia are as specific characters, has not yet been determined to my satisfaction.

HABITAT

There is little difficulty in getting material for the study of the genus *Cortinarius*, once its haunts are known. One may tramp a whole day through the woods, and hardly find a specimen, even in proper season. As is well known, the genus is eminently *northern* or found in temperate altitudes, and this, with the fact that they occur in the *autumn*, would indicate that they love the cool wood and shady brook. In the region of pine and spruce, or in old beech forests, where the shade is dense and the ground is saturated with moisture — there one may nearly always find spots where they abound. Especially is this the case when the forest covers a hill or ravine along whose slope are found rivulets at intervals of a few yards. Even then one is impressed with the remarkably local character of their occurrence. They need a substratum which is capable of retaining moisture for a considerable time, because they are slower of development than are many others of the fleshy mushrooms. Moisture and the nature of the forest trees seem, as far as at present known, to determine their home. I have collected as many as twenty species within a radius of a few rods. Sometimes a single beech tree is the centre, around which can be found a half dozen or more kinds. Such a case was a swamp of maple, oak and young hemlock, in which a beech tree, standing by itself, was the center of a 15-foot radius, and within the area made by it were found: a troop of 32 specimens of *C. squamulosus* Pk.; also *C. multiformis* Fr., *C. bolaris* Fr., *C. torvus* Fr., and three smaller kinds which were not identified. On entering a new field, a beech forest was invariably a successful collecting ground, when near-by places yielded nothing. So far, our plants were found more often near beech or hemlock. Whether there is some symbiotic relation is an interesting question.

IDENTIFICATION

To make this paper as useful to the beginner as possible, and at the same time further the study of the plants of this interesting

FIGURE 6. *Cortinarius Atkinsonianus* Kauff. Natural size. Spores as in Fig. 1.

genus, it will be necessary to point out a few matters relating to their collection and study. It is sometimes desirable to send away one's specimens for identification, and a lack of certain observations that should have been made in the field may prevent any one from giving them much attention.

It is absolutely useless to pick up an old, dried specimen of *Cortinarius*, and ask any one to recognize it. Once in a while some easily known plant may be recognized in that way, but in the majority of cases old plants of different species look so much alike that it is mere guessing to say anything about them. The first thing to remember is that young, unexpanded plants must be examined as well as mature ones. Next a careful description must be made, *with special reference to the difference in the color of the gills in the young and old plants.* Then a similar comparison of the color of pileus and stem ; and then a search for an annulus or universal veil, and its character. Finally a careful test of the pileus and stem for gluten or viscidity. (One must remember that old, dry plants may lose this character.) These points are absolutely essential. In addition to the above, the following characters are often useful : the shape of the pileus ; the size of the parts ; the smoothness of the surface of pileus and stem ; the character of the edge of the gills ; the nature of the bulbous base of the stem ; the appearance of the flesh. In fact, the notes cannot be too full, *provided they contain the essential facts mentioned first.*

SPECIES

In working over the material, it was found that the chief difficulty lay in the lack of an extensive key to the American species. It is true that Professor Earle * has compiled one from the descriptions of the authors ; and although his key sometimes gave me a clue to a species, it also led me astray. This is not so much a reflection on the key — which is admittedly a compilation — it rather shows how unsatisfactory are studies which are made from the descriptions alone. The key which is here presented, although worked out and tested on fresh plants alone, must necessarily have many shortcomings. The possibility of mistaking descriptions of species, especially of European origin, is great. Photographs and

* Torreya 2 : 169, 180. 1902.

colored drawings have been made of all the species presented in the key. These, with the dried specimens, have been compared with the type specimens of Professor Peck at Albany, or with European exsiccati in the Cryptogamic Herbarium of Harvard University. The writer here wishes to acknowledge the kindness and courtesy shown him by both Professor Farlow and Professor Peck.

The species included in this key are only such as were found in the vicinity of Ithaca, N. Y., and which could, with a high degree of certainty, be identified. Almost as many more, not included in the key, need further study. It is hoped that the list may not be less useful to students in other localities, even if it is local. Most of the European species included have been reported for New York by Professor Peck.

The natural relationships of the species have been more or less violated in the key, since its maker has had in mind not a final grouping, but a help for beginners.

A PARTIAL KEY TO THE CORTINARII IN THE VICINITY OF ITHACA, N. Y.

A. Pileus with a gelatinous cuticle, more or less viscid or glutinous when moist, as is also the stem in some species. [*Myxacium* and *Phlegmacium*.]

Pileus coarsely corrugate. *C. corrugatus* Pk.

Pileus not corrugate.

Taste of the surface of the pileus extraordinarily bitter; plants small.

C. vibratilis Fr.

C. amarus Pk.

Taste not very bitter.

Spores large, 10 to 16 μ long.

Stem cylindrical and long; entire plant very viscid.

Stem with evanescent scales, or none.

C. cylindripes sp. nov.

Stem with broken, concentric rings of floccose scales.

C. collinitus (Pers.) Fr.

Stem bulbous or short.

Spores 10–12 μ long.

Color very pale yellow with olivaceous tinge.

C. olivaceus-stramineus sp. nov.

Color yellow to orange-ochraceous; no olivaceous tinge.

C. multiformis Fr.

Spores 13–16 μ long; stem violaceous to blue.

C. Atkinsonianus sp. nov.

Spores smaller, 6–9 μ long.

Pileus with dark olivaceous tinge.
C. anfractus Fr.
Pileus with a violaceous or purple color.
Flesh and gills turning purple when bruised.
C. purpurascens Fr.
Flesh not turning purple.
Stem with marginate bulb.
C. caerulescens Fr.
Stem clavate or slightly bulbous. (Pileus sometimes almost pale yellow.)
C. Berlesianus Sacc. & Cub.
Stem subequal; plants small.
C. croceo-caeruleus (Pers.) Fr.
Pileus some shade of yellow; no tinge of violet.
Pileus covered by gluten; stem viscous when moist.
C. sphaerosporus Pk.
Pileus not covered by gluten; pileus deep tawny-orange; stem marginate-bulbous.
C. fulgens (Alb. & Schw.) Fr.
Pileus some shade of drab. *C. sterilis* sp. nov.

B. Cuticle of pileus not composed of gelatinous fibers, hence never viscid nor gelatinous. [*Inoloma*, *Telamonia*, *Dermocybe*, and *Hydrocybe*.]
Spores 10–12 μ long; plants not whitish nor violaceous.
Plants small, 2–4 cm. tall. *C. badius* Pk.
Plants longer, about 8 cm. tall.
Stem with cinnabar-colored, persistent, concentric rings.
C. armillatus (Alb. & Schw.) Fr.
Stem sheathed by the veil, *i. e.*, peronate.
C. torvus Fr.
Spores 4–9 μ long; if longer, plants are whitish or violaceous.
Stem and pileus scaly or shreddy.
Scales red (scarlet to vermillion). *C. bolaris* (Pers) Fr.
Scales brown to blackish.
Plant large, watery-spongy, soon dark chocolate-colored.
C. squamulosus Pk.
Plants of medium size, wood-brown.
C. pholideus Fr.
Stem not scaly.
Stem with more or less persistent annular rings or peronate.
Plants large, 1–8 cm. or more tall; pileus proportionately broad.
Pileus ochraceous, clay-colored, or tawny.
Stem at first peronate by the white universal veil; pileus at first buff. *C. flavifolius* Pk.
Stem at first peronate by the tawny-yellow universal veil; pileus at first tawny-yellow.
C. annulatus Pk.
Entire plant saffron-yellow.
C. croceocolor sp. nov.
Pileus bluish to purple when young; buff to tan when old.

Stem stout, 10–20 mm. thick; pileus punctate.
C. umidicola sp. nov.
Stem more slender, 5–10 mm. thick; pileus not punctate.
C. deceptivus sp. nov.
Plants small, subannulate; pileus less than 3–4 cm. broad.
Pileus watery-cinnamon, smooth.
C. lignarius Pk.
Pileus fuscous, when young covered with white, villose fibrils.
C. paleaceus (Weinm.) Fr.
Stem with no annulus, or annulus evanescent.
Stem bulbous or clavate.
Bulb depressed-marginate; gills heliotrope-purple when young.
C. obliquus Pk.
Bulb clavate.
Color of plant lilac to whitish.
Plants usually larger than in the next; lilac color persistent. *C. lilacinus* Pk.
Plants of medium size; violet tinge evanescent.
C. alboviolaceus (Pers.) Fr.
Color of pileus some shade of buff.
C. caespitosus Pk.
Color of entire plant deep-chrome, unchanging.
C. callisteus Fr.
Stem subequal or tapering downward.
Pileus not hygrophanous.
Pileus cinnamon-colored; stem yellow; no olivaceous tinge.
Gills at first yellow.
C. cinnamomeus (L.) Fr.
Gills at first flame-scarlet.
C. semisanguineus flamineus var. nov.
Gills at first dark blood-red.
C. semisanguineus Fr.
Pileus tawny-olive; stem yellow, olive-tinged.
C. croceus Fr.
Pileus and stem scarlet or blood-red.
Pileus broad as compared with the rather short stem; spores 8 x 5 μ. *C. cinnabarinus* Fr.
Pileus narrower, stem longer; spores 6 x 4 μ.
C. sanguineus (Wulf.) Fr.
Pileus distinctly hygrophanous.
Plant small; pileus 2 cm. broad or less.
Pileus conical at first; stem slender.
C. subflexipes Pk.
Pileus convex at first.
Stem stout, smooth; pileus chestnut-colored.
C. castaneus (Bull.) Fr.
Stem slender, fibrillose; pileus fuscous.
C. fuscoviolaceus Pk.
Pileus broader than 2 cm.

Pileus tawny-orange to cinnamon ; stem pale.
C. armeniacus (Schaeff.) Fr.
Pileus watery-cinnamon ; gills very distant.
C. distans Pk..

Cortinarius sterilis sp. nov.

(*Myxacium*)

Pileus 1.5–4.5 cm. broad, suborbicular when young, then convex-expanded, margin incurved, drab, drab-gray to olive-buff (Ridg.),* even, smooth, *viscid*, somewhat umbonate at times. Flesh white, soft, thin. Gills relatively broad, 4.6 mm., drab-gray (Ridg.) at first, then light cinnamon, rounded behind, then emarginate, not at all ventricose, rather crowded ; edge serratulate and white, later eroded, *provided with sterile cells.* Cortina white or sordid. Stem 4–8 cm. long, 4–6 mm. thick, at base 10 mm., hence clavate or tapering upward, solid, spongy, dingy-white, tinged towards apex with light blue, clothed when fresh with the delicate patches of the *viscid*, universal veil, which is of the same color as the pileus, within pale bluish at apex, white below. Spores 6–7 $\mu \times$ 5–6.5 μ, subspheroid, rather smooth. Plants slender. (FIGURE 1.)

Low places, near sphagnous swamps, near Freeville, N. Y. August 1904, *C. H. Kauffman.*

Cortinarius cylindripes, sp. nov.

(*Myxacium*)

Pileus 3–7 cm. broad, *very glutinous at first* and shining, later opaque, at the very first lavender, then yellowish with a violaceous tinge, at length becoming brownish-ochraceous, with the appearance of being stained by these colors at various stages, obtusely orbicular when young, then campanulate and expanded, rather small in comparison with the length of the stem ; margin incurved and pellucid-striate ; surface smooth, at length longitudinally wrinkled. Flesh thick on disk, thin elsewhere, violaceous, soon dingy-white. Gills rather broad, at length 5–8 mm., adnate, emarginate, not attenuate towards margin of pileus, *violaceous or lavender when young*, becoming pale cinnamon, not crowded, thin, edge serratulate and paler, somewhat wrinkled at the sides but not veined. Stem 8–10 cm. long, 5–9 mm. thick, elastic, *remarkably equal*, covered by a violaceous, *glutinous*, universal veil which sometimes remains as evanescent patches and at its junction with the partial veil as a slight annulus, smooth or fibrillose-striate at

* Ridgeway, Nomenclature of colors.

apex, violaceous to dingy-white within, solid or stuffed; *entire stem usually a beautiful pale azure-blue.* Spores 12–15 $\mu \times 6.5$–8 μ, slightly tuberculate; basidia about 10 μ long. (FIGURE 2.)

Gregarious, rarely cespitose. Entire plant is soft and quickly decays. Under hemlock trees, Enfield Gorge, Coy's Glen and Fall Creek Ravine, July to September, 1903–4, *C. H. Kauffman.*

Related to *C. elatior*, from which it differs in its equal stem, which is never scaly and is always violaceous to blue; the gills are lavender when young and the whole plant is very viscous.

Cortinarius olivaceo-stramineus sp. nov.

(*Phlegmacium*)

Pileus 4–7 cm. broad, viscid from a gelatinous cuticle, broadly convex, slightly depressed in the center when expanded, margin incurved for some time, *pale straw-yellow with an olivaceous tinge*, slightly rufous-tinged when old, smooth or silky-fibrillose, disk sometimes covered with minute squamules, shreds of the partial veil attached to the margin when expanded. Flesh *very thick*, becoming abruptly thin towards margin, white, dingy-yellowish in age, *soon soft and spongy.* Gills rather narrow, 7 mm. broad, sinuate-adnexed, whitish at first, then pale cinnamon, crowded, edge serratulate and paler. Stem 6–8 cm. long, 5–12 mm. thick, with a slight bulb when young, from whose margin arises the dense partial veil; white and very pruinate above the veil, which remains as dingy fibrils stained by the spores, spongy and *soft* within, becoming somewhat hollow. Veil white with an olive tinge. Spores 10–12 $\mu \times 5.5$–6.5 μ, granular within, almost smooth. Odor agreeable. (FIGURE 3.)

To be placed under the division "*scaurus*," where it comes near *C. herpeticus* Fr., but the gills when young are never violet-tinged.

Near Green-Tree Falls, and Freeville, N. Y., August, 1903, *H. H. Whetzel* and *J. M. Van Hook.*

Cortinarius umidicola sp. nov.

(*Telamonia*)

Pileus as much as 16 cm. broad (generally 6–7 cm. when expanded) hemispherical, then convex and expanded, with the margin for a long time markedly incurved; *young cap heliotrope-purplish* with umber on disk, or somewhat fawn-colored (Ridg.), *fading very quickly to pinkish-buff*, in which condition it is usually

found ; margin when young with narrow strips, of silky fibrils from the universal veil ; pileus when old covered with innate, whitish, silky fibrils, hygrophanous ; *surface punctate*, even when young. Flesh of stem and pileus lavender (Ridg.) when young but soon fading to a sordid white, thick on disk, abruptly thin towards margin, soon cavernous from grubs. Gills very broad, as much as 2 cm., *at first lavender*, soon very pale-tan to cinnamon, rather distant, thick, emarginate with a tooth, at first plane then ventricose ; edge slightly serratulate, concolorous. Stem as much as 13 cm. long (usually 8 to 10 cm.), 1–2 cm. thick, usually thickened below and tapering slightly upwards, mostly thicker also at apex, rarely attenuate at base, sometimes curved, always *stout*, solid, lavender above the woven, sordid white, universal veil, which at first covers the lower part as a sheath, but soon breaks up so as to leave a band-like annulus half-way or lower down on the stem, or remains on the base of the stem as white fibrillose patches ; soon of same color as pileus, hygrophanous, soon cavernous. The annulus is easily rubbed off, leaving a bare stem. Cortina violaceous-white. Spores 7–9 μ × 5–6 μ, almost smooth ; basidia about 40 μ long. (FIGURE 4.)

Troops of 25 plants were found under a clump of hemlock trees on the edge of a swamp, north of Freeville, N. Y., August 29, 1903, and August 22, 1904, *C. H. Kauffman.*

Cortinarius croceocolor sp. nov.

(*Telamonia*)

Pileus 3–7 cm. broad, convex then expanded, saffron-yellow, with dense, dark brown, erect squamules on disk ; whole surface has a velvety appearance and feel, scarcely hygrophanous, even. Flesh of pileus yellowish-white, rather thin except on disk, slightly hygrophanous, scissile. Gills cadmium-yellow (Ridg.), moderately distant, rather thick, emarginate, rather broad, 8–9 mm., width uniform except in front where they taper quickly to a point. Stem 4–8 cm. long, tapering upwards from a thickened base, *i. e.*, *clavate-bulbous*, 9–15 mm. thick below, *peronate three-fourths of its length by the chrome-yellow to saffron veil*, paler above the veil, solid, saffron-colored within, hygrophanous, soon dingy, attached to strands of yellowish mycelium. Spores subspheroid to short-elliptical, 6.5–8 × 5.5–6.5 μ, echinulate when mature. (FIGURE 5.)

Gregarious or solitary in mixed woods, August 1904, Coy's Glen and Mich. Hollow swamp, Ithaca, N. Y., *C. H. Kauffman.* Entire plant is often saffron-colored.

Cortinarius Atkinsonianus sp. nov.

Pileus 8 cm. broad, expanded, *wax-yellow or gallstone-yellow to clay-colored and tawny* (Ridg.), colors very striking and sometimes several present at once, *viscid*, smooth, even, somewhat shining when dry. Flesh thick, except at margin, bluish-white like the stem, or paler, scarcely or not at all changing when bruised. Gills comparatively narrow, 6–8 mm., width uniform except near outer end, adnate becoming slightly sinuate, *purplish* to yellow, then cinnamon. Stem *violaceous-blue*, 8 cm. long, 12–15 mm. thick, equal or slightly tapering upward, *bulbous* by a rather thick, marginate bulb 3 cm. thick, hung with the fibrillose threads of the universal veil, which is a beautiful pale-yellow and clothes the bulb even at maturity; violaceous-blue within, solid. Spores 13–15 $\mu \times 7$–8.5 μ, *very tubercular*. (FIGURE 6.)

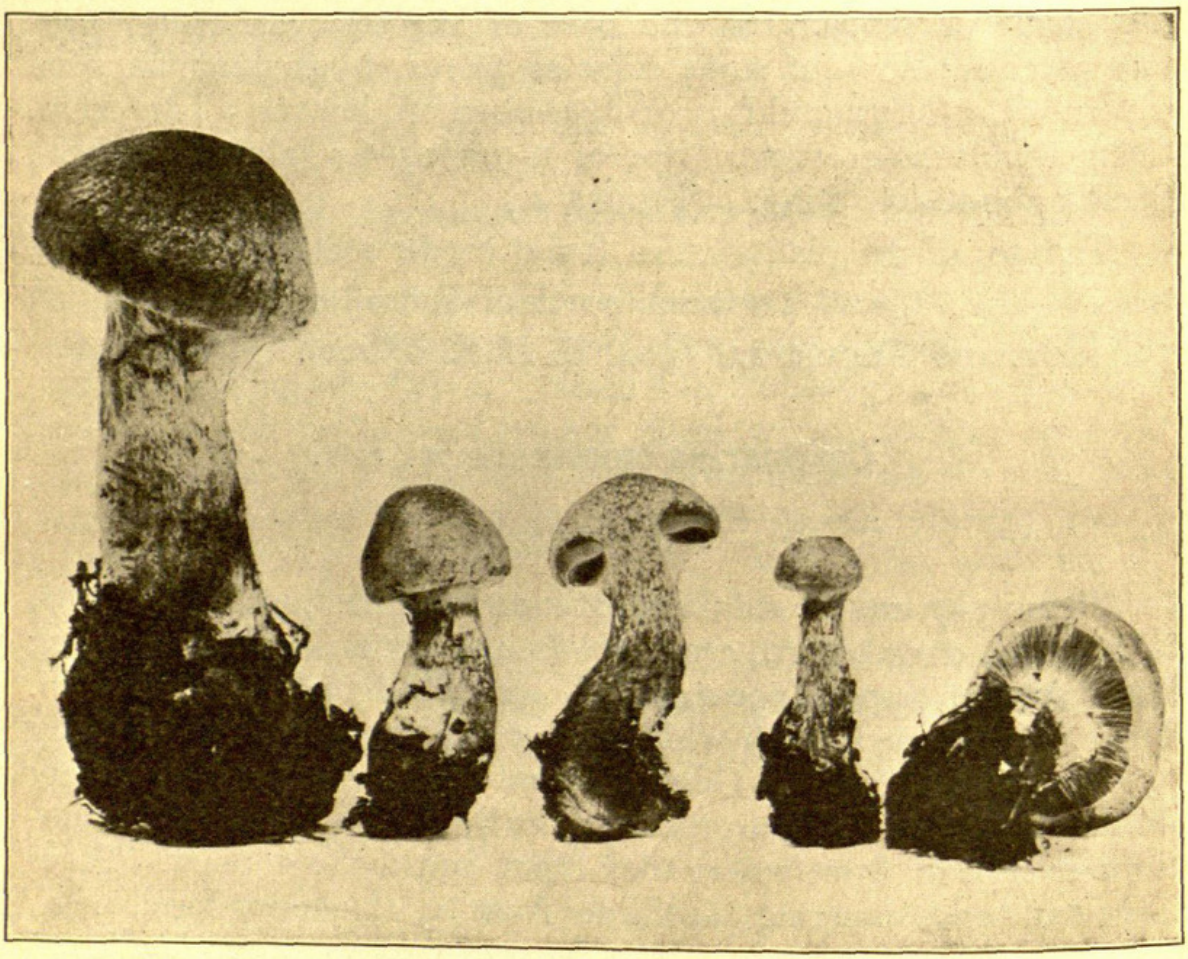

FIGURE 7. *Cortinarius deceptivus* Kauff. Slightly reduced. Young stages.

The nature of the universal veil indicates its position in the subgenus *Telamonia*, but the viscid cuticle bars it. It needs further study. Only a single, rather mature specimen was found, among hemlocks and poplars, at the base of a sassafras sapling, Enfield Gorge, near Ithaca, N. Y.. September 14, 1903, *C. H. Kauffman.*